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(12) **Patent:** (11) **CA 718794**

(54) COIL GRAB

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ABSTRACT:

CLAIMS: Show all claims

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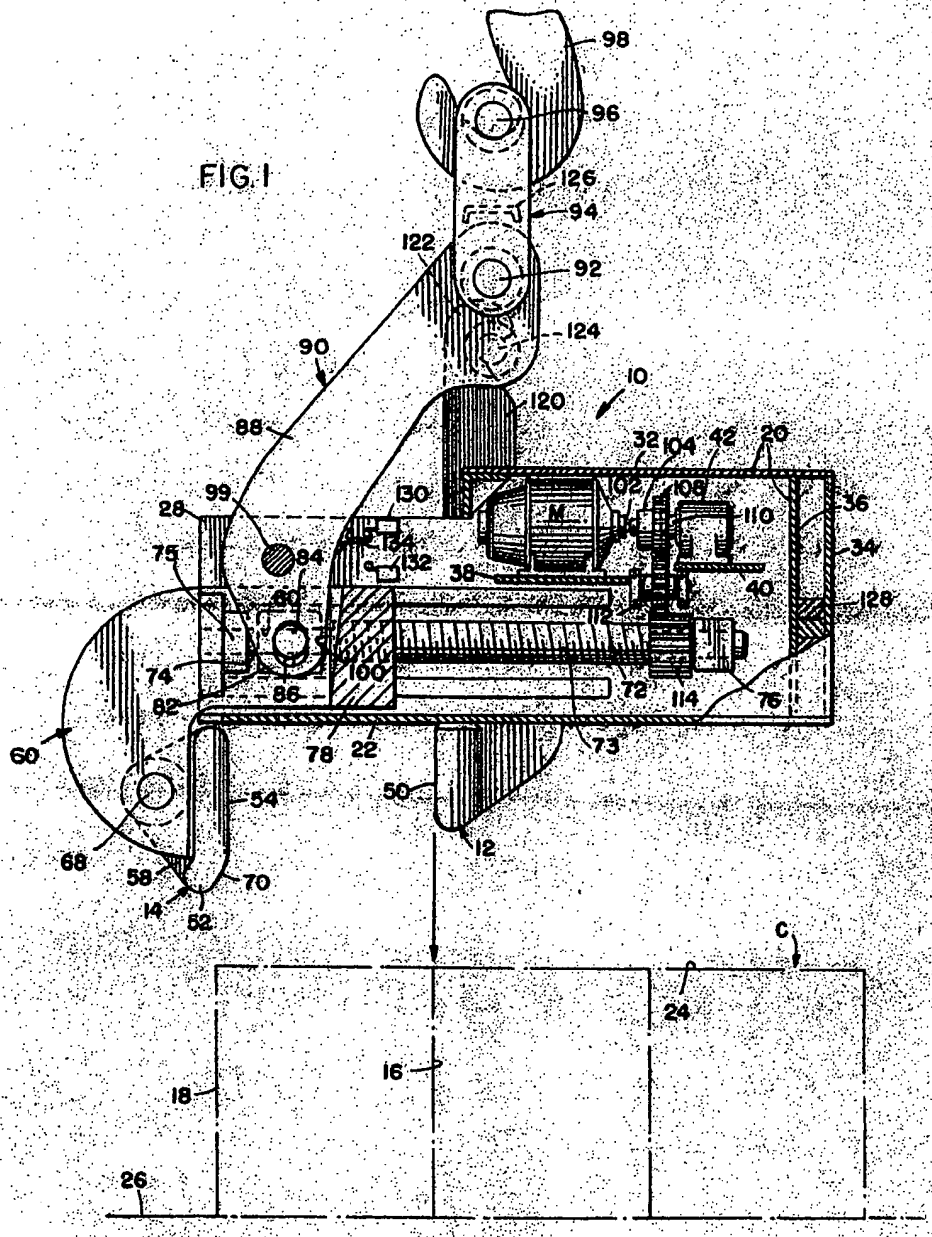
Important Notices

FIG. 1



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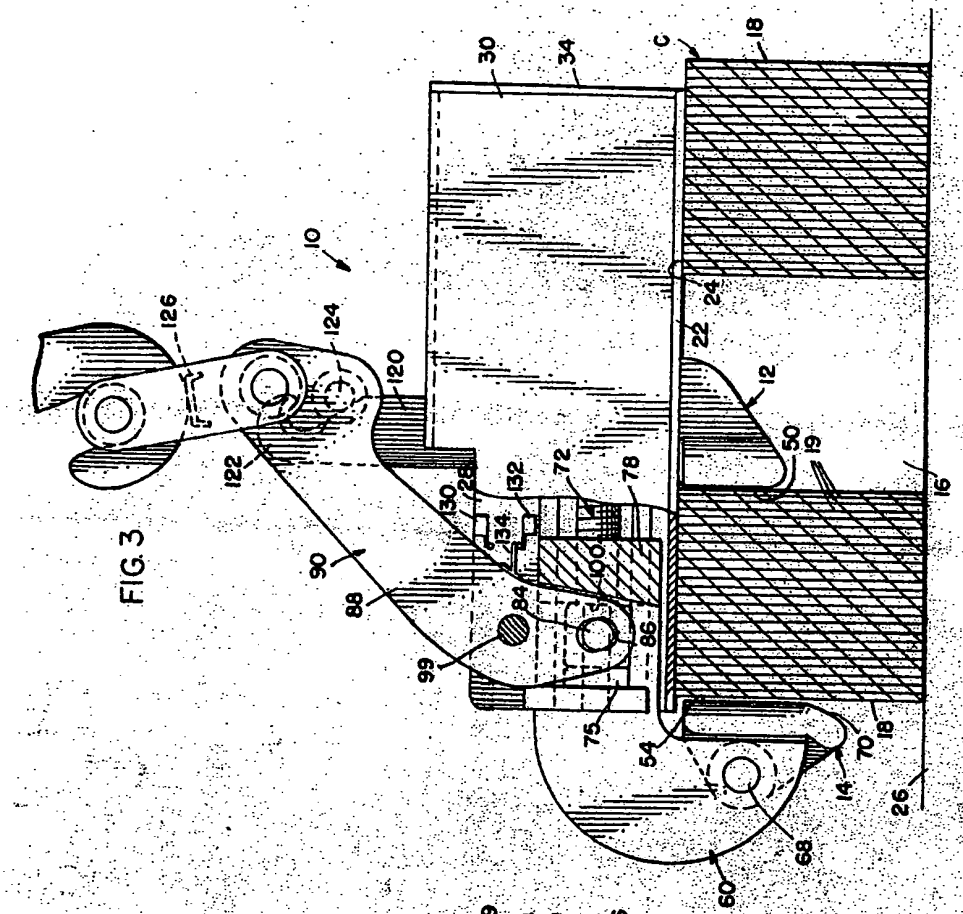

FIG. 3

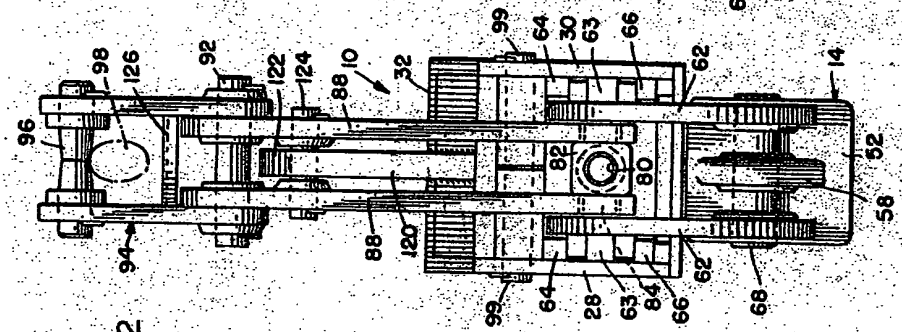

FIG. 2

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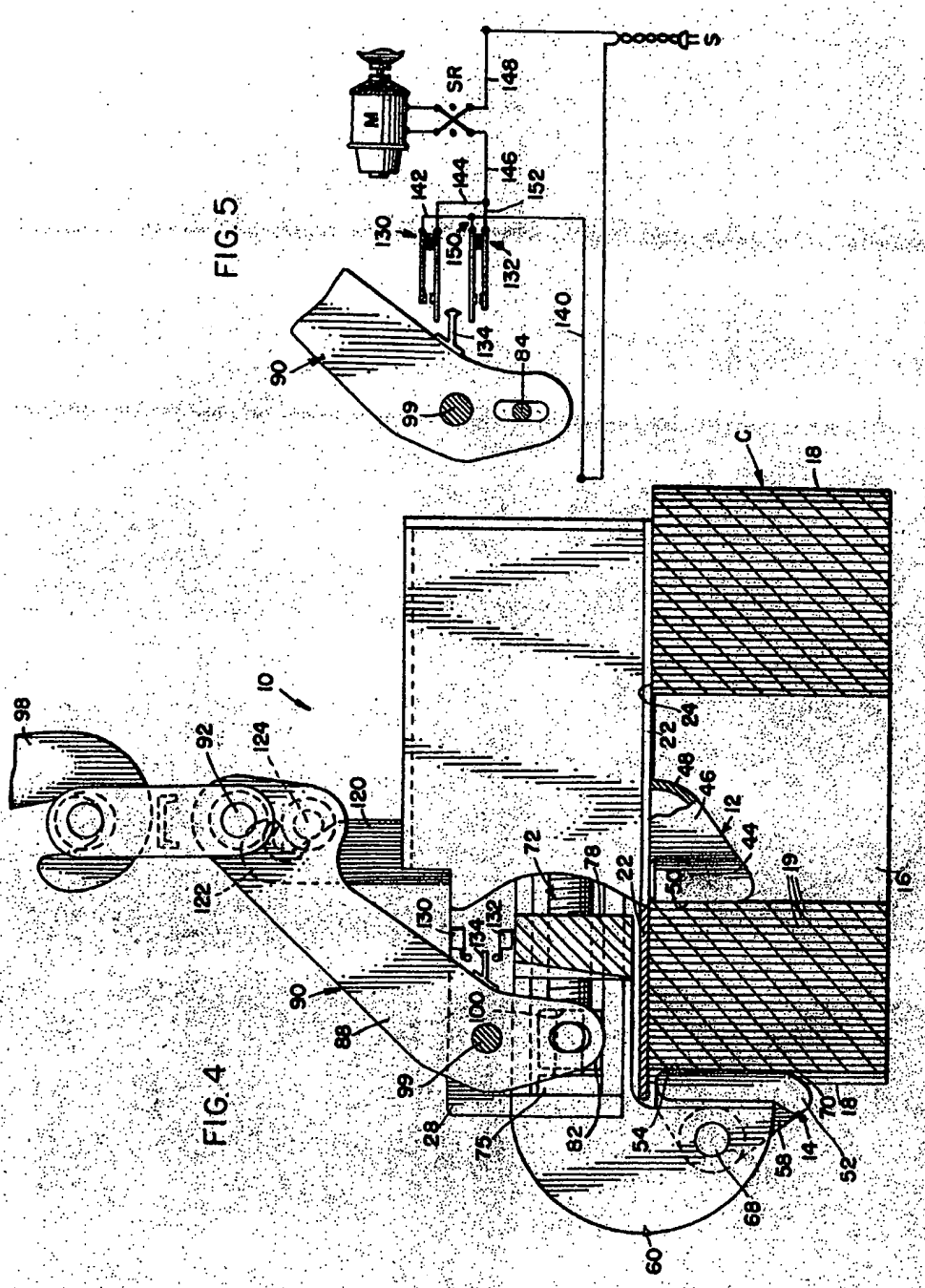

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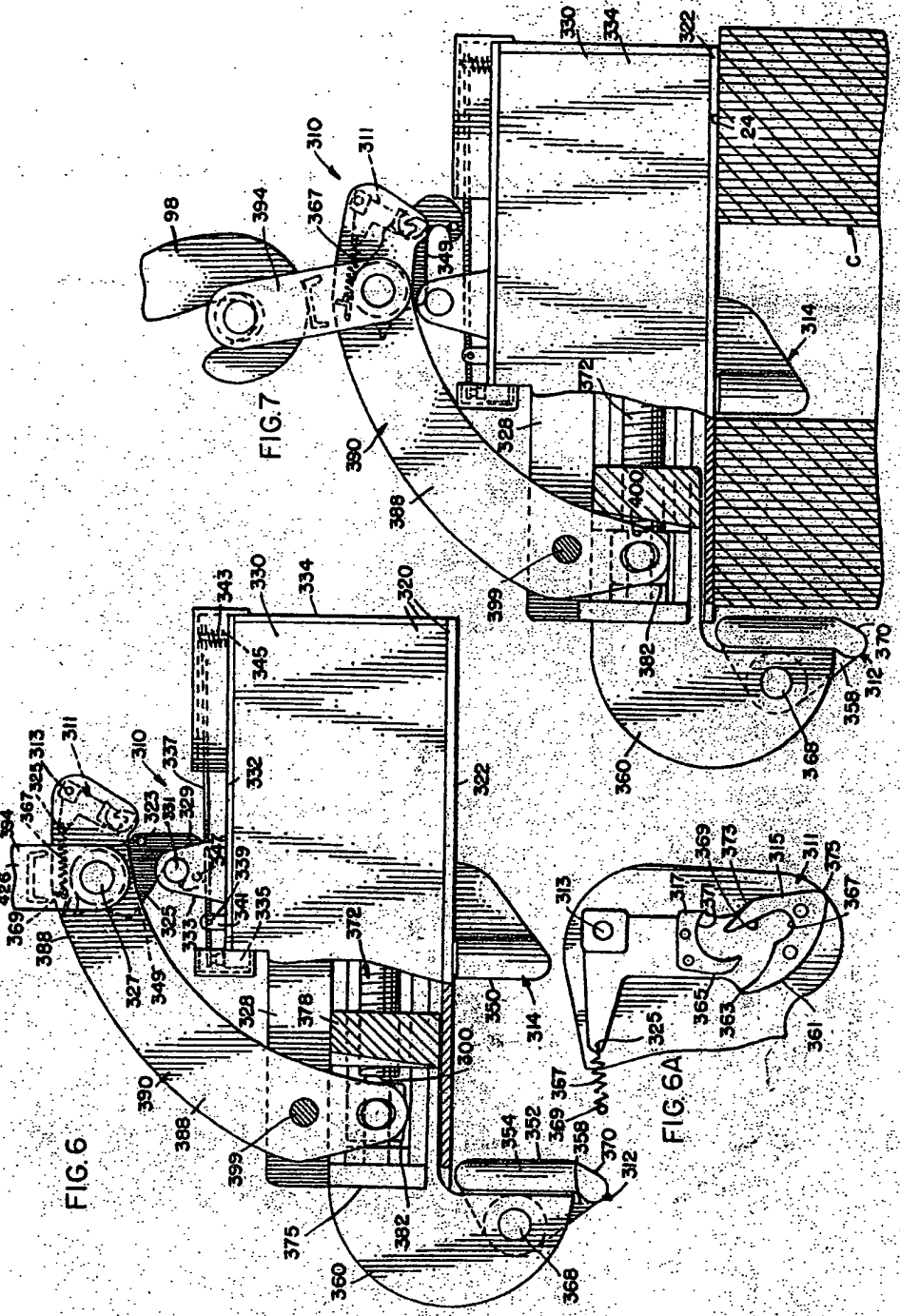

FIG. 6

FIG. 6A

FIG. 7

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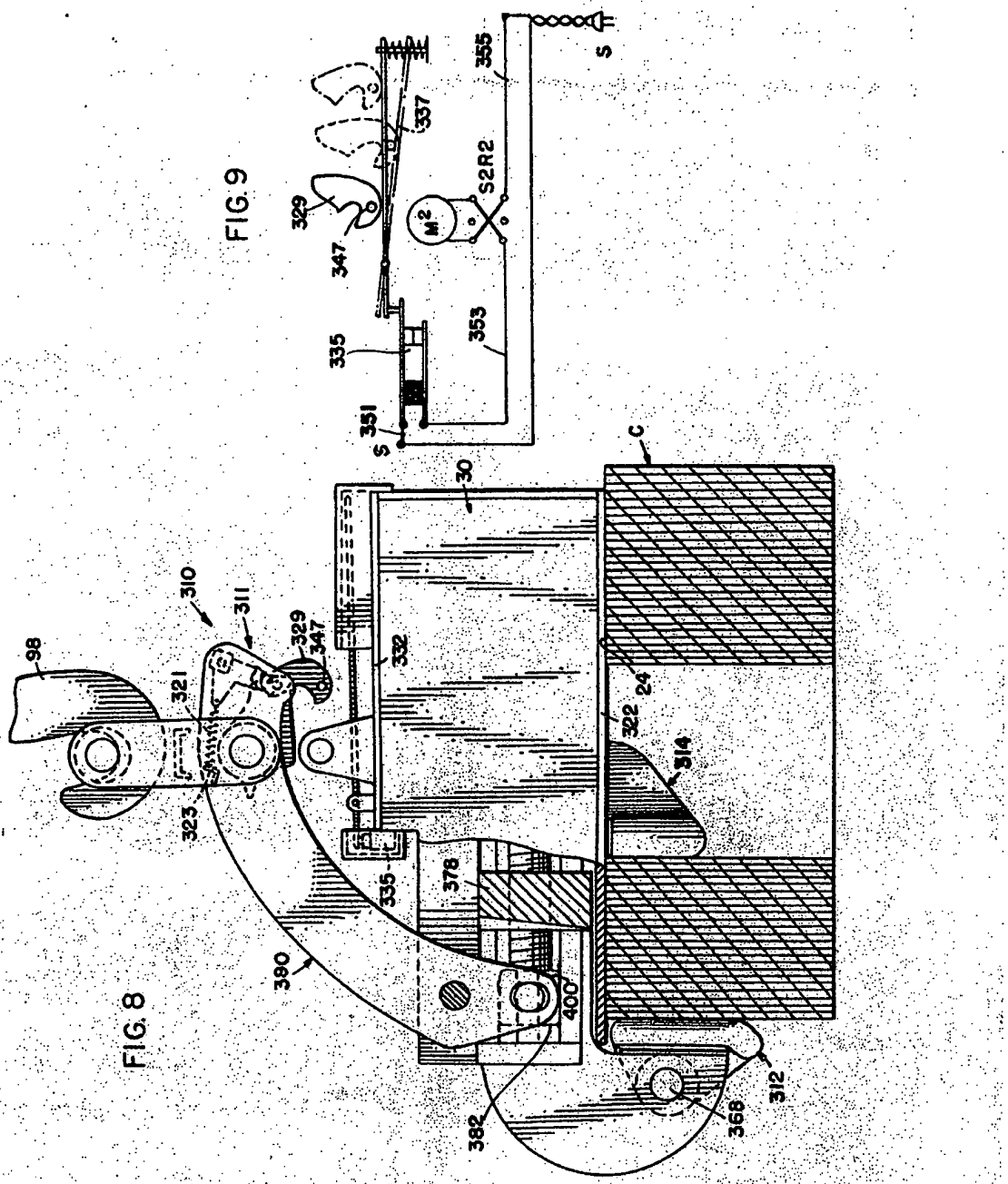

FIG. 9

FIG. 8

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The present invention relates to motorized industrial coil lifters of the type commonly known as coil grabs inasmuch as they include cooperating jaws which engage the cylindrical coil wall therebetween and exert inward pressure upon the same to tightly compress the convolutions of the coil and obtain a sufficient grip upon the coil wall as to enable the coil to become elevated from the supporting surface when the lifter as a whole is bodily raised. Coil grabs of this general character are commonly employed at the steel mill for handling relatively heavy and massive coils of sheet metal stock which are wound in involute fashion to produce the cylindrical coils. A coil grab of this type is to be distinguished from a lifter which employs cooperating tongs having either tong foot members adapted to slide beneath a coil when the latter is disposed in a vertical position on a pallet, or tong fingers adapted to enter the central bore of a horizontally disposed coil when the latter is disposed in a horizontal position on the floor or other supporting surface.

Present day motorized coil lifters are of two general types, namely, the tong type wherein the coil-gripping jaws are carried at the lower ends of a pair of motor driven tong arms which, by virtue of a limited mechanical advantage offered by the tong leverage action, exert a gripping force on the coil walls to assist in lifting, and the horizontally extensible jaw type wherein a motor driven movable jaw is capable of being driven toward and away from a fixed jaw on the coil lifter frame.

The limited gripping force which can be attained with either of these types of lifters renders them incapable of lifting objects such as coils by friction alone and thus such lifters are invariably provided with foot members which are adapted to pass beneath the object to be lifted so as to carry the major portion

of the load.

Where lifting must be accomplished solely by means of a friction grip, a grab-type mechanism is employed which operates upon the principle of a conventional ice tong, one example of such a grab being shown and described in United States Patent to Zito, No. 2,803,489, dated August 20, 1957 and entitled "Load Lifting Device of the Self-Gripping Type."

Such tong type grabs are possessed of several limitations that leave much to be desired from the standpoint of efficiency. In the first place, in order to accommodate the lifting of coils having coil walls of varying thicknesses, the extent of jaw spread must be appreciable. This, of necessity, requires the use of tong arms which are relatively long and thus have a wide sweep. Movement of the tong arms from open-jaw to closed-jaw position and vice versa requires a very appreciable head room unless an additional manual jaw opening adjustment is imposed into the mechanism. Where such grabs are concerned, the adjustment requires the use of additional operating personnel on the floor and it also necessitates an interruption in the use of the machine during the effecting of the adjustment.

An equally serious limitation that is attendant upon the use of tong type coil grabs resides in the fact that in order to move the grab away from a previously deposited coil, it is necessary to open the grab jaws to the fullest extent of which they are capable before the jaw mechanism can be latched to disable the gripping action and permit the empty grab to be hoisted. This requires an appreciable amount of idle hoist operation for moving the tong arms between their extreme open-jaw and closed-jaw positions each time a coil is handled. This, in light of the large vertical hoist displacement involved in driving the jaws, is a

-ime-consuming operation. A third limitation that is attendant upon the use of tong type coil grabs resides in the fact that because the empty coil grab must be locked in a collapsed condition while traveling between successive coils to be lifted, such locking precludes the operator from performing the time-saving expedient of operating the jaws to condition the grab for engagement with the next succeeding coil to be lifted during the travel time of the empty grab between coils.

The present invention is designed to overcome the above-noted limitations that are attendant upon the construction and use of conventional coil grabs and, toward this end, it contemplates the provision of a coil grab which embodies certain of the advantageous features of a tong type coil grab and certain other advantageous features of a horizontally movable jaw coil lifter to produce a grab which possesses the high gripping power ordinarily associated with a tong type grab but which does not require an inordinate amount of head room or wide aisle space between adjacent coil rows; which will release a given coil as soon as the gripping pressure on the coil wall is relieved so that it is not necessary to move the jaws to their extreme open position before the empty grab may be lifted away from a coil, or to move the jaws between their extreme positions each time a coil is engaged, lifted, transported and deposited at a remote location; which will enable the operator to make jaw adjustments while the empty grab is in transit between coils so that the grab may be caused to arrive in the vicinity of a given coil to be lifted with the jaws in an approximately correct condition for operative coil engagement; and which need make no compromise between jaw travel speed and power train gear reduction inasmuch as coil gripping force is not dependent upon motor output torque.

The provision of a coil grab of the type briefly outlined above being among the principal objects of the invention, it is a further and important object to provide a grab having associated therewith a fixed jaw and a movable jaw, the latter being slidably carried at the lower end of a tong arm so as to be movable toward and away from the fixed jaw in the usual manner of tong operation when the upper end of the tong arm is moved in one direction or the other, together with auxiliary and independently operable motor driven means for shifting the movable jaw toward and away from the fixed jaw without affecting the position of the tong arm or its fulcrum point. By such an arrangement, the power which is employed for shifting the movable jaw in this manner may be applied directly to the coil wall by closure of the jaws against the same to compress the coil laminations and take up most of the lost motion which may exist by virtue of looseness of the laminated structure, after which the tong arm may be operated in the usual manner to exert a powerful gripping action upon the coil wall while at the same time effecting lifting of the grab bodily to elevate the coil from the supporting surface.

A still further object of the invention in a coil grab of this character, is to provide a novel automatic safety control mechanism by means of which the operator is obliged to position the coil grab as a whole relatively to a coil to be lifted in such a manner that when the jaws are closed upon the coil well they will fully engage the wall coextensively with the jaws so that all operative gripping points on the jaws will obtain the benefit of frictional resistance to jaw slippage.

A similar and related object of the invention is to provide such a coil grab whereby such initial positioning of the grab mechanism relatively to the coil is a prerequisite to the attain-

ment of sufficient tong action to effect coil elevation. By such an arrangement, in the event that the operator attempts to elevate the coil without so initially positioning the coil grab for full coil engagement, coil slippage will take place immediately instead of after the coil has been elevated.

Yet another object of the invention is to provide a coil grab having associated therewith novel latch mechanism which is automatically operable when theoperator lifts the empty grab without load to disable the tong action of the grab, and which is also automatically operable when the operator lifts the coil-loaded grab to render the tong action effective.

A still further object of the invention is to provide a coil grab of this sort which reduces the amount of jaw movement incident to each complete coil-transporting operation to a minimum.

The above-mentioned objects are related to principal features of novelty associated with the present invention but numerous other ancillary objects and advantages of the invention not at this time enumerated will become readily apparent as the nature of the invention is better understood.

In the accompanying five sheets of drawings forming a part of this specification, two exemplary embodiments of the invention have been shown.

In these drawings:

Fig. 1 is a side elevational view, partly in section, of a coil grab constructed in accordance with the principles of the present invention and showing the same in a suspended load-free position;

Fig. 2 is an end elevational view of the structure shown in Fig. 1 with certain parts removed in the interest of clarity;

Fig. 3 is a fragmentary side elevational view of the structure shown in Fig. 1 showing the coil grab in an initial coil-engaging position preparatory to closure of the coil-engaging jaws upon a coil;

Fig. 4 is a side elevational view similar to Fig. 3 showing the coil grab in an elevated coil-supporting position;

Fig. 5 is a circuit diagram, schematic in its representation, of the electrical instrumentalities associated with the coil grab of Fig. 1;

Fig. 6 is a side elevational view, partly in section and similar to Fig. 1, showing a modified form of coil grab constructed according to the present invention;

Fig. 6a is an enlarged plan view of a latch member employed in connection with the present invention;

Fig. 7 is a fragmentary side elevational view similar to Fig. 3 showing the coil grab of Fig. 6 in an initial coil-engaging position;

Fig. 8 is a side elevational view similar to Fig. 4 showing the coil grab of Fig. 6 in an elevated coil-supporting position; and

Fig. 9 is a schematic circuit diagram of the electrical instrumentalities associated with the coil grab of Fig. 6.

Referring now to the drawings in detail and in particular to Figs. 1 to 4, inclusive, in these views one exemplary form of coil grab constructed in accordance with the principles of the present invention has been illustrated in several different positions. In Fig. 1 the empty grab, which has been designated in its entirety at 10, is shown as being positioned above a coil C to be lifted preparatory to be lowered into coil-engaging position. In Fig. 3 the grab 10 is shown as being seated upon the

upper annular face of the coil C preparatory to closing of the grab jaws upon the coil. In Fig. 4 the grab is shown as being operatively applied to the coil C in lifting relationship and with the grab under the full load of the coil which is suspended thereby.

The grab 10 involves in its general organization a fixed jaw 12 and a movable jaw 14, the latter being movable in opposite directions horizontally toward and away from the fixed jaw for coil clamping purposes. When in operative lifting relationship with respect to the coil C as shown in Fig. 4, the fixed jaw 12 projects into the central bore 16 of the coil, while the movable jaw 14 engages the cylindrical outer surface 18 of the coil. The various involute coil laminations 19 are thus "squeezed" or compressed between the two jaws 12 and 14 with sufficient pressure being exerted upon the coil to permit lifting of the latter without danger of slippage.

The jaw 12 is fixedly secured to the underneath portion of the grab framework 20 and it depends below the level of a flat thrust plate 22 which constitutes a portion of the framework 20. The thrust plate 22 is adapted to seat upon the upper end 24 of the coil C as shown in Fig. 3 at the time that the grab is initially brought into lifting relationship with respect to the coil while the latter is supported upon the floor 26 or other supporting surface from which the coil is to be elevated, all in a manner and for a purpose that will be made clear presently. The framework 20 further includes side plates 28 and 30, respectively (Fig. 2), a top plate 32, a rear plate 34, a vertical partition wall 36, and a pair of transversely extending supporting shelves 38 and 40 for an electric motor M and a gear reduction device 42, respectively.

The fixed jaw 12 includes a relatively heavy jaw body 44, a pair of triangular reinforcing webs or gussets 46 and an inclined plate 48 which bridges the two webs 46. The front face 50 of the jaw body 44 is of convex cylindrical configuration to accommodate the curvature of the cylindrical bore 16 of the coil C.

The movable jaw 14 includes a jaw body 52 having a front face 54 of concave cylindrical configurationto accommodate the curvature of the outside cylindrical surface 18 of the coil C, and a plurality of rearwardly extending ear 58 by means of which the jaw as a whole is pivoted on a jaw carriage 60. The jaw carriage 60 is comprised of a pair of spaced parallel vertically disposed plates 62 (Fig. 2) which carry adjacent their upper longitudinal edges respective shoes 63 which are confined between upper and lower fixed hardened steel guide rails 64 and 66, respectively, mounted on the side plates 28 and 30. The forward or outer ends of the plates 62 project downwardly below the level of the flat thrust plate 22 and a pivot pin 68 extends between the plates and projects through the ear 58, thus pivotally mounting the jaw body 52 on the carriage 60 for limited rocking movement thereon. The lower edge of the curved jaw body 52 is flared downwardly and outwardly at 70 to assist in guiding the jaw into operative relationship with the coil C during initial coil and grab alignment. From the above description it will be seen that the movable jaw assembly, including the jaw 14 and its supporting carriage 60, is capable of horizontal sliding movement in a fore and aft direction so that the jaw body 52 may be moved toward and away from the fixed jaw body 44 for coil-engaging and coil-releasing purposes, respectively. The pivotal connection between the jaw 14 and its supporting carriage 60 enables the jaw

to align itself with the outer surface 18 of the coil.

A relatively heavy feed screw 72 having a threaded portion 73 and a non-threaded portion 74 extends longitudinally of the framework 20 and is rotatably and slidably journalled at its ends in front and rear bearing assemblies 75 and 76. The threaded portion of the screw 72 receives thereon a nut 78 adapted to travel longitudinally along the screw. The nut 78 is fixedly secured to the carriage 60 and moves bodily therewith so that upon rotation of the screw 72 the carriage will be fed in one direction or the other longitudinally of the grab.

The non-threaded portion 74 of the feed screw 72 projects through and is rotatable in a cylindrical bore 80 provided in a slide block 82 having trunnions 84. The trunnions project into vertical slots 86 provided in the lower ends of a pair of spaced parallel side members 88 which considered collectively constitute an elongated tong or lever arm 90. The upper end of the tong arm 90 carries a load-carrying cross pin 92 which is pivoted to the lower end of a lifting bail 94. The upper end of the bail 94 carries a hook-engaging pin 96 designed for cooperation with the lifting hook 98 of an overhead crane or other suitable hoisting mechanism. The lower medial region of the tong arm 90 is pivotally connected to the grab framework 20 by means of a pivot pin 99 which extends transversely between the side plates 28 and 30 and which passes through the two side members 88 as best seen in Fig. 2. The lower end of the tong arm 90 is connected to the slide block 82 by a pin and slot connection 101.

The feed screw 72 is capable of limited longitudinal axial sliding movement in the bearings 75 and 76 for a purpose that will become clear presently. The slide block 82 is adapted to bear at its rear side against a thrust shoulder 100 and an

appreciable clearance exists between the front face of the block and the front bearing 75 thus determining the extent to which the feed screw 72 may shift longitudinally of the grab framework 20.

As best seen in Fig. 1, the feed screw 72 is adapted to be selectively rotated in either direction through a power train leading from an electric motor M suitably mounted on the supporting shelf 38. The power train extends from the motor shaft 102 through a conventional torque limiting device 104 and the gear reduction device 42 and it includes a gear train having an input gear 108 mounted on the output shaft 110 of the gear reduction device, an idler gear 112 and a relatively wide output gear 114 mounted directly on the feed screw 72 and keyed to the latter. The width of the gear 114 is such as to accommodate the full extent of longitudinal shifting movement of the feed screw while maintaining full mesh between the gear 114 and the idler gear 112.

A supporting link 120 projects upwardly from the medial regions of the grab framework 20 and has its lower region welded or otherwise secured thereto. The upper end of the link 120 is formed with a hook portion 122 designed for cooperating with a secondary lift pin 124 which extends between the side members 88 of the tong arm 90 near the upper end of the latter and immediately below the cross pin 92. A pressure bar 126 extends across the lifting bail 94 and is adapted to be engaged by the underneath side of the lifting hook 98 under certain circumstances when the operator of the overhead crane is in the process of engaging a coil and as will be set forth presently.

As shown in Fig. 1, the previously mentioned vertical partition wall 36, in combination with the end wall 34, establishes a compartment or space adapted to contain a ballast or counterweight 128 in order to compensate for any unbalanced

forces which may exist when the grab assembly is suspended from the lifting hook 98.

Still referring to Fig. 1, upper and lower limit switches 130 and 132 respectively are suitably mounted on the grab framework 20 and are designed for selective cooperation with an actuating finger 134 carried on the tong arm 90. As shown in the circuit diagram of Fig. 5, the two limit switches 130 and 132 are connected in electrical parallel in the circuit for the electric motor M so that upon engagement of either limit switch by the actuating finger 134, the normally open motor circuit will become closed. Specifically, and as shown in the circuit diagram of the limit switch 130, a circuit will exist from one side of the power line S through leads 140 and 142, contacts of the switch 130, leads 144, 146, reversing switch SR, motor M, and lead 148 to the other side of the line. Upon closure of the limit switch 132 a similar circuit will exist from the power line S through leads 140, 150, contacts of the switch 132 leads 152, 146, reversing switch SR, motor M and lead 138 back to the line. The reversing switch SR is adapted to be positioned at a remote location, for example, in the operator's cab of the overhead crane or hoist.

In the operation of the apparatus, when the empty grab 10 is suspended from the crane lifting hook 98 with the pin 124 supporting the hook portion 122 of the supporting link 120, and consequently supporting the entire weight of the grab 10 as shown in Fig. 1, the tong arm 90 is biased in a counterclockwise direction so that the slide block 82 is held against the thrust bearing 100 and the feed screw 72 is retained rearwardly, i.e., to the right but no load is imposed upon the feed screw. The actuating finger 134 on the tong arm 90 remains in engagement with

-ne upper limit switch 130 so that the motor circuit is capable of being closed by the operator who may actuating the reversing switch SR at will to cause operation of the motor in one direction or the other as desired. The operator will normally cause the feed screw 72 to be actuated in a direction to move the nut 78 to the left as viewed in Fig. 1 and shift the jaw carriage 60 to a position wherein the movable jaw 14 is removed from the fixed jaw 12 a distance sufficient to accommodate reception of the wall of the coil C to be lifted between the same. The operator will then lower the grab 10 over the coil, with the two jaws 12 and 14 straddling the wall of the coil, until such time as the thrust plate 22 seats squarely upon the upper end face 24 of the coil as shown in Fig. 3.

Continued lowering of the lifting hook 98 will place the entire weight of the grab 10 upon the coil and subsequently the pin 124 will move downwardly and be released from the hook portion 122 of the hooked supporting link 120, thus relieving the tension on this link. The downward movement of the pin 124 relatively to the hook portion 122 may be augmented by the weight of the lifting hook 98 and its supporting structure bearing against the pressure bar 126 carried by the bail 94 which in turn acting through lift pin 92 forces the upper end of the tong arm 90 downwardly. This downward movement of the upper end of the tong arm 90 causes the arm to pivot about the axis of the pin 99 in a clockwise direction as viewed in Fig. 3 so that the slide block 82 moves to the left and engages the front feed screw bearing 75.

As soon as the tong arm 90 commences its clockwise swinging movement, as set forth above, the actuating finger 134 moves out of operative engagement with the limit switch 130, thus disabling the motor circuit so that the operator may not close the movable

jaw 14 against the fixed jaw 12 to grip the coil therebetween. As soon as the actuating finger 134 engages the lower limit switch 132, the motor circuit again becomes potentially closed and the operator may then actuate the reversing switch SR of the motor M to rotate the feed screw 72 in a direction to cause the movable jaw 14 to move horizontally toward the fixed jaw 12 so that the two jaws will engage the wall of the coil and compress the same therebetween, thus forcing the screw 72 in the direction of the front bearing 75 and until the thrust shoulder 100 engages the slide block 82. At such time as the wall of the coil has been engaged and "squeezed" by the two jaws 12 and 14, continued rotation of the motor shaft 102 will effect slipping of the torque limiting device 104 with no further rotation of the feed screw taking place. At this time, however, sufficient pressure is exerted upon the wall of the coil to compress the various coil laminations 19 against one another and take up most of the slack which may exist in the coil due to the loosely wound laminations thereof.

With the grab in the condition just outlined, the operator will then actuate the crane to cause the lifting hook 98 to become elevated so as to engage the pin 96 and lift the bail 94. At this time, a powerful tong leverage action will obtain and the lower end of the tong arm 90 will operate through the trunnions 84 to force the slide block 82 to the right as viewed in Fig. 1. Such movement of the slide block will shift the feed screw 72 and nut 78 to the right and cause the entire jaw-supporting carriage 60 and movable jaw 14 carried thereby to exert, in combination with the fixed jaw 12, a powerful gripping action on the coil for lifting purposes. Continued upward movement of the lifting hook 98 and bail 94 will cause the thus gripped coil

to be elevated from the supporting surface as shown in Fig. 4 for transportation to a remote location.

It is to be noted at this point that since the upper limit switch 130 is engaged by the actuating finger 134 when the weight of the grab is borne by the hooked link 120, the contacts of this limit switch remain closed so that the operator may energize the motor circuit for actuation of themovable jaw 14 in either direction of movement. He is thus unable to close the jaws 12 and 14 prematurely upon the coil C before the thrust plate 22 has become seated upon the upper end face 24 of the coil. In such an instance, inasmuch as the pin 124 will not have moved away from the hooked end 122 of the link 120, the slide block 82 will remain in contact with the thrust bearing 100 and the feed screw 72 will have no freedom of movement under the influence of the upward thrust exerted upon the tong arm 90 by the lifting bail 94. In other words, the tong arm will not be freed for independent counterclockwise swinging movement due to the engagement between the supporting link 120 and the pin 124. Therefore, the only pressure that will be applied for coil-gripping purposes is that which is supplied by the motor M through rotation of the feed screw 72 and the design of the apparatus is such that this pressure is insufficient to compress the coil laminations 19 to such an extent that the coil may be lifted. Any attempt on the part of the operator of the overhead crane to raise the lifting hook 98 for coil lifting purposes at this time will result in the jaws 12 and 14 slipping from the coil wall and without elevation of the coil from the supporting surface.

The hooked portion 122 of the supporting link 120 and the cooperating pin 124 constitute in effect a pin and slot type lost-motion connection which must be made effective before

sufficient gripping pressure can be imposed upon the coil to lift the same from the supporting surface. Unless the thrust plate 22 be caused to seat upon the upper end face 24 of the coil, the supporting link 120 cannot be freed from the pin 124 and the lost-motion necessary to tightly compress the coil laminations preparatory to coil-lifting operations cannot be attained by the tong arm, because the tong arm 90 itself is not freed for swinging movement in a counterclockwise direction. If the tong arm is not thus freed, the pin 124 serves as a secondary lift pin and bears the entire weight of the grab. Stated otherwise, the hook portion 124 constitutes a limit stop abutment for the upper end of the tong arm 90 to limit the extent of counterclockwise swinging movement of the tong arm when the grab is empty.

Mere touching or seating of the thrust plate 22 upon the upper end face 24 of the coil C and the consequent relief of lifting pressure upon the pin 124 is not sufficient to effect adequate jaw pressure upon the coil C to permit lifting of the coil. The pin 124 must move downwardly away from the hook portion 122 of the supporting link 20 a sufficient distance to establish the necessary lost motion clearance between the slide block 82 and the thrust bearing 100 at the time the wall is initially engaged by the jaw 14 so that the feed screw 72 may be shifted fully to the left for subsequent slack take-up and coil compressing operations when the leverage offered by the tong arm 90 is exerted upon the feed screw due to lifting of the upper end of the tong arm as previously described.

Referring now to Fig. 5, it will be noted that the finger 134 has an appreciable path of travel between the two limit switches 130 and 132. A slight initial clockwise movement of the tong arm 90 will cause the finger 134 to immediately disengage

che limit switch 130 and open the motor circuit so that the gripping jaws are inoperative and cannot be moved. These jaws will remain inoperative until such time as the finger 134 has traveled the full distance between the two limit switches and has engaged the limit switch 132, thus again establishing the motor circuit so that the jaws may be operated. By such an arrangement, the motor circuit may be energized only when the pin 124 is in lifting engagement with the hook portion 122 during hoisting of the empty grab, or when the thrust plate 22 is seated on the upper end of the coil and the lifting action of the crane hook 98 is ineffective so that the tong arm 90 moves to an extreme clockwise position. Stated otherwise, the gripping jaws of the grab may not be motor-actuated in an intermediate position of the tong arm.

By virtue of the phenomena described above, upon initially elevating the crane hook 98 after the thrust plate 22 has been seated on the coil C, the gripping pressure imposed upon the coil will result in a slight counterclockwise movement of the tong arm 90 which will be sufficient to move the actuating finger 134 out of contact with the limit switch 132 to interrupt the motor circuit. Thus, when the coil is suspended during transportation thereof from one place to another, the operator may not inadvertently open the motor circuit and drop the coil.

After the coil C has been lifted in the manner previously described and the crane lifting hook 98 lowered so as to lower the grab as a whole and deposit the coil C on the supporting surface 26 at a remote location, the tong arm 90 will move in a clockwise direction so that the actuating finger 134 will again shift to the limit switch 132, thus closing the contacts of the latter switch and enabling the operator to actuate the motor M

in a direction to cause jaw opening movements for coil-releasing purposes.

In Figs. 6 to 9, inclusive, a modified form of coil grab 310 has been illustrated. In this form of the invention, the grab framework 320, the fixed and movable jaws 312 and 314, respectively, the tong arm 390, the motor M2 (Fig. 9), and the power train including the gear reduction device and gear train leading therefrom remain substantially the same or similar to the corresponding parts in the form of the invention previously described so that needless repetition of description may be avoided by the application of corresponding reference numerals but of a higher order to the corresponding parts as between Figs. 1 to 4, inclusive, and Figs. 6 to 9, inclusive.

In this latter form of the invention the hooked supporting link 120 of Fig. 1, its cooperating pin 124, the two limit switches 130 and 132 and the actuating finger 134 have been dispensed with and in their stead there have been substituted a different form of latch mechanism and safety control circuit.

As best seen in Figs. 6, 6a and 8, a spring-biased flatoing latch member 311 is pivoted as at 313 adjacent to the upper end of the tong arm 390 and is provided with a latch seat 315 and an overlying latch guide shoulder 317. A spring 367 has one end attached as at 369 to the tong arm 390 and has its other end attached as at 321 to the latch member 311 and serves to bias the floating latch member to a mid-position of equilibrium.

The floating latch member 311 is designed for cooperation with a latch pin 323 provided on a hook plate 325 which is pivotally supported from a suspension pin 327. The lower end of the hook plate 325 is provided with a hook portion 329 designed for cooperating with a pin 331 carried at the upper end of a

supporting ear 333.

A limit switch 335 having normally open contacts is adapted to be engaged by an actuating arm or lever 337 pivoted as at 339 on a bracket 341 carried on the top plate 332 of the grab framework 320. The rear end of the actuating lever 337 is normally urged upwardly by means of a compression spring 343 mounted on a guide post 345 so that the normally open contacts of the limit switch 335 are yieldingly urged to their closed position. The hook plate 325 carries an actuation pin 347 which is designed for engagement with the lever 337 but which, when the hook plate 325 and pin 331 are in operative engagement, is normally maintained out of contact with the lever 337. As will be described in greater detail when the operation of the grab is set forth, when the hook plate 325 moves downwardly relatively to the pin 331 and leaves the same, the lower end of the hook plate is caused to swing to the right as viewed in Fig. 6 due to a camming action which takes place between the pin 331 and an inclined cam surface 349 on the inside of the hook portion 329. In thus swinging to the right, the pin 347 engages the lever 337, as shown in dotted lines in Fig. 9, and causes the same to rock in a clockwise direction against the action of the compression spring 343, thus releasing the limit switch 335 and allowing the normally open contacts thereof to move to their normal position and open the motor circuit. Continued swinging movement of the hook plate 325 will finally cause the pin 347 to move away from the lever 337, as shown in Fig. 9 in broken lines, so that the lever will again engage the limit switch 335 and close the normally open contacts thereof to restore the motor circuit.

The limit switch 335 is disposed in the motor circuit, as shown in Fig. 9, so that upon closure of the contacts associated

therewith a circuit will extend from the power line S through lead 351, limit switch 335, lead 353, reversing switch S2R2, motor M2 and lead 355 back to the line S.

In the operation of the apparatus shown in Figs. 6 to 9, inclusive, when the empty grab 310 is suspended from the crane lifting hook 98, as shown in Fig. 1, and with the hook portion 329 of the hook plate 325 supporting the pin 331, and consequently, the entire weight of the grab 310, the tong arm 390 is biased in a counterclockwise direction so that the slide block 382 is forced against the thrust shoulder 300 and the feed screw 372 is rearwardly, i.e., to the right, as shown in Fig. 6, but no load is imposed upon the feed screw. The actuating pin 347 remains out of engagement with the lever 337 so that the contacts of the limit switch 335 are closed and the motor circuit is under the control of the crane operator who may actuate the reversing switch S2R2 at will to drive the motor in either direction as desired.

After causing the feed screw 372 to shift the jaw carriage 360 to the left, as viewed in Fig. 6, thus to open the jaws to such an extent that they may straddle the coil wall, the grab 310 may then be lowered over the coil so that the jaws will straddle the coil wall and the thrust plate 322 will seat squarely upon the upper end face 24 of the coil. Thereafter, continued lowering of the hook 98 will place the entire weight of the grab 310 upon the coil and as a consequence the hook plate 325 will move downwardly and release the pin 331 while at the same time it will make camming engagement with the surface 349 so that it will swing to the right as viewed in Fig. 6. The pin 323 will contact the underneath surface 361 of the latch seat 315, thus causing the latch 311 to rotate bodily in a counterclockwise

direction about the axis of the pin 313 until such time as the pin 323 clears the upper end 363 of the seat 315 and moves against the side 365 of the latch shoulder 317. At the same time, the tong arm 390 will move in a clockwise direction while the slide block 382 will move to the left and engage the front feed screw bearing.

As soon as the hook plate 325 commences its downward movement as described above the pin 347 engages the lever 337 and moves the same against the action of the spring 343, thus causing the left-hand end of the lever to release the limit switch 335 and allow the normally open contacts associated therewith to become open to prevent energizing of the motor circuit. The circuit will remain open until such time as the hook plate 325 has been swung fully to the right and the slide block 382 has engaged the front thrust bearing 375. At this time the hook plate will assume the broken line position wherein it is shown in Fig. 9 and the pin 347 will release the lever 337 and effect closing of the contacts of the limit switch 335.

The operator of the crane may at this time energize the motor circuit and cause operation of the motor M2 so as to effect rotation of the feed screw 372 in a direction to close the jaws 312 and 314 on the wall of the coil in the manner previously described. At such time as sufficient pressure is exerted upon the wall of the coil to tightly compress the laminations thereof, the torque limiting device 404 will slip and no further rotation of the feed screw will take place. The operator may now elevate the crane lifting hook 98 so as to engage the lift pin 396 and lift the bail 394 and thus exert an upward pull upon the tong arm 390 and effect a powerful gripping action upon the coil for lifting purposes in the manner previously described in connection with

the form of the invention shown in Figs. 1 to 5, inclusive. As the crane hook 98 is raised to lift the coil from the supporting surface, the latch seat 315 will maintain the hook plate in the out-of-the-way position described above and as shown in Fig. 8. Continued raising of the coil grab 310 will place the entire weight of the grab and coil upon the tong arm 390 and effect the powerful gripping action of the jaws 312 and 314 on the coil wall as previously described in connection with the form of the invention shown in Figs. 1 to 4, inclusive.

After the coil C has been transported to the remote location and the crane hook 98 and bail 394 lowered to deposit the coil on the supporting surface, continued downward movement of the grab will cause the pressure plate 322 to seat upon the upper end surface 24 of the coil so that the tension on the tong arm 390 will be relieved. As the hook 98 and bail 394 continue their downward movement, the pressure of the hook upon the plate 426 will lower the upper end of the tong arm so that the pin 323 will ride upwardly on the surface 369 and onto the surface 371 of the latch shoulder 317 where it will remain until such time as the coil has been released and the empty coil grab again elevated.

At this point, the operator will actuate the motor M in a direction to move the jaw 314 away from the jaw 312 a distance just sufficient to release the coil wall, after which he will elevate the crane hook 98 and pull the upper end of the tong arm 390 upwardly. The pin 323 will then ride downwardly relative to the latch seat 315 and slide on the outside surface 373 thereof until it clears the bottom end 375 of the seat, whereupon the spring 318 will restore the latch member 311 to its normal floating position of equilibrium and the parts will be restored to the position in which they assume in Fig. 6.

The two forms of the invention disclosed herein possess several important features in common. Among these are the slidable mounting of a movable jaw at the lower end of a tong arm, together with power-actuated means for shifting the jaw toward and away from a fixed jaw without affecting the position of the tong arm or shifting its fulcrum point; the use of such power means for driving the movable jaw against the coil wall to preliminary compress the coil laminations and the subsequent availability of a true tong action for tightening the grip on the thus compressed coil wall for coil-lifting purposes; the availability of a powerful tong gripping action to preclude the dropping of the coil even in the event of a power failure; the availability of such power means for shifting the movable jaw during transportation of the empty, load-free coil grab in accordance with an estimate of the wall thickness of the next coil to be engaged; the availability of the tong action until such time as the coil wall has been fully straddled by the jaws; and the automatic disabling of the tong action prior to complete coil release so that it is not necessary to effect a full tong stroke to attain such tong disabling.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. Only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a motorized coil grab of the character described for clamping the cylindrical wall of an involutely wound coil or the like and thereafter transporting the coil from one location to another, in combination, a frame, a fixed jaw depending from said frame and designed for clamping engagement with the inner side of the cylindrical coil wall, a movable jaw depending from and slidably disposed on said frame, capable of horizontal movement forwardly toward and rearwardly away from said fixed jaw, and designed for clamping engagement with the outer side of the cylindrical coil wall, a tong arm pivoted medially of its ends to said frame for swinging movement about a horizontal axis between two extreme positions and in the general direction of the movements of the movable jaw, a primary lift pin on the upper end of said tong arm and designed for engagement with an overhead hoist for exerting a lifting action on the tong arm, an elongated feed screw mounted for rotation on the frame about an axis coincident with the path of movement of the movable jaw and capable of limited axial sliding movement, means establishing a threaded connection between the feed screw and movable jaw whereby rotation of the feed screw in opposite directions will effect horizontal movement of the movable jaw in opposite directions respectively, means defining a rearwardly facing shoulder on the feed screw, means defining a forwardly facing shoulder on the lower end of the tong arm, the shoulder on the tong arm being designed for engagement with the shoulder on the feed screw when

Claim 1 continued

said lift pin is engaged and lifted by said hoist to force the feed screw to move in a forward direction, interengaging limit stop means on the frame and tong arm for limiting the extent of swinging movement of which the tong arm is capable when said lift pin is engaged and lifted by said lift hook, said interengaging limit stop means comprising a secondary lift pin on said tong arm adjacent to the upper end thereof, and an upwardly projecting frame-supporting link having a hook portion overlying said pin and designed for engagement by the latter when the tong arm, during lifting thereof, has been swung through a predetermined angle in a direction to effect forward movement of the feed screw, said primary lift pin and tong arm serving to support the frame when said limit stop means is ineffective, said primary lift pin, a portion of said tong arm, said secondary lift pin, and said frame-supporting link serving to support the frame when said limit stop means is effective, and a motor for selectively rotating said feed screw in opposite directions.

2. In a motorized coil grab of the character described for clamping the cylindrical wall of an involutely wound coil or the like and thereafter transporting the coil from one location to another, in combination, a frame, a fixed jaw depending from said frame and designed for clamping engagement with the inner side of the cylindrical coil wall, a movable jaw depending from and slidably disposed on said frame, capable of horizontal movement forwardly toward and

Claim 2 continued

rearwardly away from said fixed jaw, and designed for clamping engagement with the outer side of the cylindrical coil wall, a tong arm pivoted medially of its ends to said frame for swinging movement about a horizontal axis between two extreme positions and in the general direction of the movements of the movable jaw, a lift pin at the upper end of said tong arm and designed for engagement with an overhead hoist, an elongated feed screw mounted for rotation on the frame about an axis coincident with the path of movement of the movable jaw and capable of limited axial sliding movement, means establishing a threaded connection between the feed screw and movable jaw whereby rotation of the feed screw in opposite directions will effect horizontal movement of the movable jaw in opposite directions respectively, means defining a rearwardly facing shoulder on the feed screw, means defining a forwardly facing shoulder on the lower end of the tong arm, the shoulder on the tong arm being designed for engagement with the shoulder on the feed screw when said lift pin is engaged and lifted by said lift hook to force the feed screw to move in a forward direction, interengaging limit stop means on the frame and tong arm for limiting the extent of swinging movement of which the tong arm is capable when said lift pin is engaged and lifted by said hoist, releasable latch means for disabling said limit stop means, means for rendering said latch means effective when said tong arm is swung throughout a predetermined minimum angle in a direction to effect rearward movement of the lower end thereof, and means for selectively rotating said feed screw in opposite directions.

3. In a motorized coil grab of the character described for clamping the cylindrical wall of an involutely wound coil or the like and thereafter transporting the coil from one location to another, in combination, a frame, a fixed jaw depending from said frame and designed for clamping movement with the inner side of the cylindrical coil wall, a movable jaw depending from and slidably disposed on said frame, capable of horizontal movement forwardly toward and rearwardly away from said fixed jaw, and designed for clamping engagement with the outer side of the cylindrical coil wall, a tong arm pivoted medially of its ends to said frame for swinging movement about a horizontal axis between two extreme positions and in the general direction of the movements of the movable jaw, a lift pin at the upper end of said tong arm and designed for engagement with an overhead hoist, an elongated feed screw mounted for rotation on the frame about an axis coincident with the path of movement of the movable jaw and capable of limited axial sliding movement, means establishing a threaded connection between the feed screw and movable jaw whereby rotation of the feed screw in opposite directions will effect horizontal movement of the movable jaw in opposite directions respectively, means defining a rearwardly facing shoulder on the feed screw, means defining a forwardly facing shoulder on the lower end of the tong arm, the shoulder on the tong arm being designed for engagement with the shoulder on the feed screw when said lift pin is engaged and lifted by said hoist to force the feed screw to move in a forward direction, reversible electric motor operatively connected to said feed screw in driving relationship, interengaging limit stop

Claim 3 continued

means on the frame and tong arm for limiting the extent of swinging movement of which the tong arm is capable when the lift pin is engaged and lifted by said hoist, said inter-engaging limit stop means comprising a secondary lift pin on said tong arm and adjacent to the upper end thereof, and an upwardly projecting frame-supporting link having a hook portion overlying said pin and designed for engagement by the latter when the tong arm, during lifting thereof, has been swung through a predetermined angle in a direction to effect forward movement of the feed screw, said primary lift pin and tong arm serving to support the frame when said limit stop means is ineffective, said primary lift pin, a portion of the tong arm, said secondary lift pin, and said frame-supporting link serving to support the frame when said limit stop means is effective, an electric circuit for the motor, a pair of normally closed limit switches disposed in said circuit and mounted on said frame in spaced relation-ship, and an actuating finger on the tong arm and movable into engagement with said limit switches to open the same when said tong arm moves to its extreme positions respectively.

4. In a motorized coil grab of the character described for clamping the cylindrical wall of an involutely wound coil or the like and thereafter transporting the coil from one location to another, in combination, a frame, a fixed jaw depending from said frame and designed for clamping engagement with the inner side of the cylindrical coil wall, a movable jaw depending from and slidably disposed on said

Claim 4 continued

frame, capable of horizontal movement forwardly toward and rearwardly away from said fixed jaw, and designed for clamping engagement with the outer side of the cylindrical coil wall, a tong arm pivoted medially of its ends to said frame for swinging movement about a horizontal axis between two extreme positions and in the general direction of the movements of the movable jaw, a lift pin at the upper end of said tong arm and designed for engagement with an overhead hoist, an elongated feed screw mounted for rotation on the frame about an axis coincident with the path of movement of the movable jaw and capable of limited axial sliding movement, means establishing a threaded connection between the feed screw and movable jaw whereby rotation of the feed screw in opposite directions will effect horizontal movement of the movable jaw in opposite directions respectively, means defining a rearwardly facing shoulder on the feed screw, means defining a forwardly facing shoulder on the lower end of the tong arm, the shoulder on the tong arm being designed for engagement with the shoulder on the feed screw when said lift pin is engaged and lifted by said hoist to force the feed screw to move in a forward direction, a suspension pin on said frame, a hook plate pivoted to the tong arm adjacent the upper end of the latter, said hook plate being formed with a hook portion adapted to engage said suspension pin for lifting purposes, a latch pin on said hook plate, a latch member pivoted to the tong arm and having a latch seat adapted to receive the latch pin therein, cam means on said hook plate and suspension pin for guiding the latch pin into operative register with the latch seat

Claim 4 continued

when said tong arm is swung throughout a predetermined minimum angle in a direction to effect rearward movement of the lower end thereof, an electric motor for selectively rotating said feed screw in opposite directions, a circuit for said motor, and means automatically operable during movement of the tong arm between said two extreme positions for preventing energization of the motor circuit.

5. In a motorized coil grab, the combination set forth in claim 4 and wherein said means for preventing energization of the motor circuit comprises a limit switch mounted on said frame, and an actuating finger on said hook plate, said actuating finger being operable to actuate the limit switch when the tong arm is in either of its extreme positions, said limit switch being operable when actuated to render the motor circuit effective.

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